The State of New Hampshire

DEPARTMENT OF ENVIRONMENTAL SERVICES

Thomas S. Burack, Commissioner

Commissioner's Declaration

Declaration of the Establishment of Protected Instream Flows for the Souhegan Designated River

Souhegan Protected Instream Flows Established

RSA 483:9-c, IV requires that the protected instream flow levels established by the Commissioner "shall be maintained at all times, except when inflow is less than the protected instream flow level as a result of natural causes or when the commissioner determines that a public water supply emergency exists which affects public health and safety." RSA 483:9-c, V requires that, "The maintenance of protected instream flows shall constitute a condition of any permit issued by the [Department of Environmental Services] for any project or activity within a designated river or segment and corridor." Env-Ws 1907.02 states that protected instream flows established by the commissioner shall serve as water quality criteria for the purpose of administration of water quality standards by DES under the federal Clean Water Act.

Protected Instream Flows are hereby established for the Souhegan Designated River as described in the Souhegan River Protected Instream Flow Report dated February 26, 2008. Table 1 provides a summary of these protected instream flow requirements. The full report is available at www.des.nh.gov/rivers/instream/souhegan/study.html and at the following locations:

File Review Room
NH Dept. of Environmental Services
29 Hazen Drive
Concord, NH 03301

Wadleigh Memorial Library
49 Nashua Street
Milford, NH 03055

New Ipswich Town Library
Main Street
New Ipswich, NH 03071

Merrimack Public Library
470 Daniel Webster Hwy
Merrimack, NH 03054

Thomas S. Burack
Thomas S. Burack, Commissioner
NH Department of Environmental Services

April 1, 2008
Date

Authority

Paragraphs RSA 483:9-c, I and RSA 483:11, IV of the Rivers Management and Protection Act require the Commissioner of the Department of Environmental Services (DES) to establish rules specifying the standards, criteria, and procedures for establishment and enforcement of protected instream flows for each designated river or segment. Env-Ws 1900, Rules for the Protection of Instream Flow on Designated Rivers, fulfill this requirement. Env-Ws 1905, Procedure for Establishment of Protected Instream Flows, describes the procedure for establishing protected instream flows. Laws of 2002, Chapter 278:3, III (b) require the Commissioner of DES to establish protected instream flows for the Souhegan River.

This document serves as the written decision required by Env-Ws 1905 to establish the Souhegan Protected Instream Flows. The process for establishing protected flows is described in Env-Ws 1905.04. The rules require a written decision, after study and public input, stating the scientific basis for the protected flows, including an assessment of how the protected instream flows will meet applicable water quality standards. The rules also require a summary of the comments and an explanation of how the comments affected the final instream flows. The review of impacts required under RSA 483:9-c, IV will be conducted in the Water Management Plan portion of the Protected Instream Flow Pilot Program, which is the next phase in this process.

Overview

Requirements for instream flow protection on Designated Rivers have been in state law since 1990, but progress was slowed by disagreement about appropriate protection methods. Legislation enacted in 2002 required DES to conduct a pilot program on a restricted scale that covered only two Designated Rivers. The Souhegan River Protected Instream Flow Report is the first study to recommend protected instream flow values under this pilot program.

The Souhegan Designated River comprises 32 miles beginning in New Ipswich and continuing to the confluence with the Merrimack River in Merrimack as described in RSA 483:15, XIII. These protected instream flows apply to the Souhegan Designated River, to water users in the watershed required to be registered under RSA 488 (Affected Water Users), and to dam owners in the watershed with impoundments greater than 10 acres (Affected Dam Owners).

The Souhegan River Protected Instream Flow Report (Report) details the methods and results used to identify the Protected Instream Flows for the Souhegan Designated River. Copies of the report are available at the public libraries in New Ipswich, Milford, and Merrimack and the DES file review room in Concord, New Hampshire. The entire report is accessible in convenient segments at www.des.nh.gov/rivers/instream/souhegan/study.html.

Scientific basis for the protected flows

The Report (February 26, 2008) details the scientific process used to develop the protected flows. The report is incorporated by reference.

The study defining instream protected flows began by identifying what was to be protected. Instream flow legislation in RSA 483:9 describes flow protection as a requirement for specific entities listed in the statute. These entities include a variety of riverine uses,

characteristics, and resources such as recreation, hydropower, aquatic life, public water supply, rare species or habitat, geologic resource, and others. Protected Instream Flows were defined by the study for those flow-dependent members of the listed protected entities.

The flow requirements for fish, riparian wildlife and vegetation were found to be the determining constituents for instream flow protection. Other flow-dependent protected entities made opportunistic use of flow conditions as they occurred. Protected instream flows for fish were developed using MesoHABSIM, a habitat simulation model, and those for riparian wildlife and vegetation were developed using a transect survey method. Both were evaluated using the framework of the Natural Flow Paradigm[1]. The Souhegan River assessment divided the River into two portions because of a significant change in river characteristics between the upper and lower portions. The river division, Natural Flow Paradigm and the major components of the protected instream assessment are described below.

River Divided Into Upper and Lower Portions

Protected instream flows were developed separately for two portions of the Souhegan Designated River. Differences in river characteristics of the upper and lower river were expected to result in different fish communities and recreational activities needing to be assessed. The river is divided in West Milford, 520 meters below the North River Road Bridge, just east of the Wilton/Milford border. Several changes in river characteristics occur in this vicinity. The river changes to a larger stream at its confluence with Stony Brook in Wilton, changing from a third-order to fourth-order (Strahler method) stream. Also, in the vicinity is a division in zoogeographic ecosystem types as mapped by Omernik[2]. This division is described as Northeastern Highlands to the west (upstream) and the Northeastern Coastal Zone to the east (downstream.) The division coincides with the approximate boundary between till covered uplands and the Milford-Souhegan glacial-drift aquifer, an area of unconsolidated glacial-drift deposits consisting primarily of stratified sand and gravel overlain by more recent alluvium. The change in ecosystem type is characterized by a dramatic topographic change as the river leaves the steep gradient hills to the west to flow through shallow gradient valleys in the east. There is a related change in the dominant substrate type from large cobble and boulders with bedrock outcrops to a dominant substrate type of sand and fine gravel. The change in substrate creates a difference in the available habitat types between the upper and lower portions of the river. These differences led to the conclusion that there would be differences in the composition of the instream fish communities between the upper and lower portions of the river. The protected flows of these two river portions were investigated, analyzed, and evaluated separately.

Natural Flow Paradigm

The Natural Flow Paradigm provides the necessary conceptual framework for describing protected instream flows. The Natural Flow Paradigm is a concept that recognizes that the natural range of flow variability is the most supportive of flow-dependent plants and animals.

To describe protected instream flows within the Natural Flow Paradigm requires a comprehensive description of stream flow incorporating magnitude, timing, frequency, duration

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[1] Poff, N. L. et al. 1997. The Natural Flow Regime. *BioScience* Vol. 47, No. 11: pp. 769-784.

[2] Omernik, J. M. 1987. Ecoregions of the coterminous United States. Map (scale1:7,500,000). Annals of the Association of American Geographers 77(1):118-125.

and rate of change. Because of the complexity inherent in the flow regime, a single, static value (i.e., minimum) would not adequately describe stream flow. Neither would prescribing a single value as a protected flow be sufficient to describe the range of flow needs for protected entities. A comprehensive description using the Natural Flow Paradigm components provides the detailed representation of flow and of flow needs that allows both water use and support of riverine entities.

By framing protected instream flows within the Natural Flow Paradigm, flow-dependent entities are protected, yet unrealistic flows are not required because variability is allowed. This more complex description of a complex system describes flow in a way that allows naturally occurring conditions like low flows to occur without considering these events as a crisis, yet limits them in frequency and duration to what the ecosystem has evolved to tolerate. Water for off-stream use will be available because of both the wide range of variability in stream flows and the flexibility of instream flow needs. Without this framework, the goal of describing protected instream flows that support flexible management providing water for both instream needs and off-stream use would be difficult.

Protected Instream Flow Assessment

Defining protected instream flows begins with identification of the entities that need protection. Using the statutory listing of river features to be protected, a preliminary list of Souhegan-specific entities was generated from electronic mapping sources, personal interviews and study reports for the Souhegan. The river was then surveyed to confirm specific occurrences of these entities and to identify others. The subset of flow-dependent entities identified was then used to choose assessment techniques to determine their flow needs. Assessment techniques were selected that are appropriate for the type of entity being assessed and are generally divided between methods for human uses, fish, and riparian wildlife and vegetation.

Human use of flow-dependent river characteristics was assessed by surveys and questionnaires. Human-related instream flow needs such as recreation, hydropower, and pollution abatement are time invariant: the desired flows for these uses are constant and do not vary throughout the year. However, these flows are not always available, thus resulting in seasonal use of the river for recreation (kayaking) and hydropower. These are traditionally opportunistic uses, such that kayakers and hydropower generators use the flows when they occur, but do not expect these flows to be continuously available. The dilution requirements for treated waste water are met within the context of the discharge permit for the facility and long term low flow trends.

Water use by fish and riparian wildlife and vegetation is different. Their use is time dependent in that their life cycles require differing flows through the year. For riparian wildlife and vegetation a floodplain transect method was used that compares bank elevations to the magnitude of flow needed to inundate those elevations. Flow timing, frequency and duration were keyed to life cycle needs. For fish, a habitat simulation model, MesoHABSIM (described below) was used. Habitat availability was defined relative to flow. Criteria for instream flows were then defined that maintain habitat availability based on the timing, duration, and frequency of the flow magnitudes that maintain those levels of habitat availability.

MesoHABSIM (habitat simulation model)

Flow requirements for fish were developed using the MesoHABSIM model. The MesoHABSIM model establishes the river-specific relationship between stream flow and habitat availability. The model evaluates the temporal distribution of habitat area to identify significant changes in frequency and duration. Consistent with the Natural Flow Paradigm, protected flows are identified that will limit the duration of flows below defined magnitudes to the natural frequency.

MesoHABSIM is an adaptation of the well known PHABSIM habitat simulation model developed by the U.S. Fish and Wildlife Service. Both models assume that habitat availability correlates positively with fish density. Both are methods of evaluating habitat change relative to stream flows. MesoHABSIM takes measurements at a biologically-significant scale that is more representative than PHABSIM of watershed-wide conditions.

MesoHABSIM estimates habitat availability as a function of flow in representative reaches. Each reach is made up of a variety of river forms and structures called hydromorphologic units such as pools, riffles, runs, glides and cascades. These river structures represent different riverine habitat, and MesoHABSIM maps each of these hydromorphologic units of the river. The representative reaches are selected by quantitative assessment of their hydromorphologic makeup based on the percentage of hydromorphological unit types in the reach relative to the river's makeup as a whole. The representative reaches assessed for the Souhegan model comprised 25% of the Designated River. MesoHABSIM uses measurements of habitat criteria collected at several locations within each hydromorphologic unit type within the representative reaches.

To carry out the MesoHABSIM model, a Target Fish Community was established for the river to identify the species expected in the Souhegan reaches. The species in the Target Fish Community are identified from fish data collected from minimally-impacted reference rivers in the northeast that have similar characteristics to the Souhegan. Separate Target Fish Communities were developed for the upper and lower Designated River portions. These community data show the critical species and the timing of their life-cycle flow needs.

Fish species in the Target Community were evaluated to define their significant life-cycle phases throughout the year. This defines the timing component of protected flows for fish. The Souhegan River study identified six critical life-cycle phases: Overwintering, Spring Flood, Shad Spawning, General Reference Adult Fish Spawning, Rearing and Growth, and Salmon Spawning. These significant life-cycle phases are called bioperiods. Each is a biologically-significant phase and is identified for one or more species in the Target Fish Community. Protected instream flows were determined for appropriate species for each bioperiod.

Habitat preference criteria were developed for fish species and life stages to determine the protected flow magnitudes, durations, and frequencies for each bioperiod. The habitat needs of the fish species were evaluated individually and collectively to define the criteria for habitat suitability. Using these criteria, the river was assessed for its suitability as habitat for the species of the target fish community. Field measurements were made of habitat parameters (depth, velocity, substrate, presence of submerged and overhanging vegetation, presence of canopy

cover, presence of woody debris, presence of shallow margins, characteristics of adjacent shoreland, and characteristics of each bank) within the representative reaches. Habitat measurements were made over a range of flows. Habitat conditions at each flow were assessed against the habitat suitability criteria to develop the relationship between flow and habitat availability.

Although flow is related to habitat availability, it is not a linear relationship. Long term records of flow exist, but not of habitat availability. To establish the natural variability of habitat availability over time, the flow-habitat relationship is used to transform long-term records of naturalized stream flow into records of daily habitat over time. These records comprise the history of habitat availability for each bioperiod.

Habitat availability in each representative reach for each bioperiod was assessed using time-series analysis. The time-series analysis yields habitat availability in terms of its duration and cumulative frequency for discrete increments of habitat magnitude. The result is a set of frequency distribution curves of habitat magnitude and duration starting at the lowest level of habitat availability that is always present. Curves are developed for incrementally higher levels of habitat availability describing their frequency and duration.

The dispersal and shape of these curves were evaluated to identify the habitat magnitudes which represent significant changes in the frequency of habitat availability. These habitat magnitudes were identified using defined frequency conditions. Three habitat magnitudes were identified to represent the protected instream flows for each bioperiod. These three magnitudes were converted from habitat availability back into flow magnitude using the relationship between habitat availability and flow. The three flow magnitudes of protected instream flows are named "common," "critical," and "rare."

Each flow magnitude was further characterized by two durations: allowable and catastrophic. These durations are identified by characteristic inflections on the habitat magnitude curve representing a discernible change in frequency of occurrence. The durations define limits on the consecutive days when flow is below a protected flow magnitude. The catastrophic durations describe lengths of times for events that occur on a decadal frequency, whereas the allowable durations include those events which would occur in an average year.

Protected instream flows were defined for each of the six bioperiods using MesoHABSIM. Each bioperiod has a common, critical, and rare flow magnitude in cubic feet per second (cfs). Each flow magnitude has an associated allowable and catastrophic duration in days.

Floodplain Transect Model

Protected instream flow requirements for wetlands, floodplains, and river bank habitats and their associated flora and fauna were determined by surveying transects across the river channel and floodplain. This method uses a habitat's elevation on the stream bank to determine flow magnitudes based on the flow that occurs when the river is at this level. Life cycle needs are determined by species to describe frequency and timing of these flows.

Cross sections and maps were constructed showing plant community boundaries and wildlife habitats associated with their topographic position. Surface water elevations along transects during low, moderate and high flow events and simultaneous stream flows from the gage station at Merrimack were recorded and added to the transect cross-section. Protected instream flows were defined as the flows associated with the water level at each identified plant community or wildlife habitat, and that are critical to important life cycle events. These include, for example:

- Filling oxbow/backwater marshes, swamps and floodplain pools during spring for plant development and breeding wildlife;
- Avoiding flooding of turtle and bird nests in the high floodplain during nesting seasons;
- Maintaining sufficient water levels for hibernating turtles and amphibians over the winter, and;
- Periodic (every one to three years) flooding and scouring of floodplain forest floors to maintain flood tolerant plant communities and prepare seedbeds.

The floodplain transect method defines protected flows using the magnitude, timing, and frequency of flows needed to support riparian wildlife and vegetation.

Identifying Protected Instream Flows from the Various Methods

Protected instream flows for a variety of flow-dependent riverine or riparian entities including recreation, fish, floodplain sycamore forests, wetlands, turtles and hydropower were defined using several methods. To determine which protected instream flows to use, the timing and magnitude of flow needs for all the various entities were compared. This comparison determined the controlling flow by determining the highest flow need of all entities. By satisfying the highest flow, all other flow needs are met. There may be some exceptions to this practice, but these were not evident in the Souhegan River.

The comparison of uses shows that the controlling protected instream flow for the Upper Souhegan portion is recreation. If this human-related instream flow were to be the controlling instream flow, the protected flow for the Upper Souhegan would be equal to flows occurring only during storm events and spring run-off and would not be sustainable. As described earlier, the recreational use arose with the expectation that only a certain frequency of flows would be available at these magnitudes. Therefore, the management strategy will consider this flow in the context of preserving the frequency of its occurrence, but will not regulate flows to meet recreation needs on a continuous basis. In the final evaluation, for both the upper and lower portions the flow requirements for fish and riparian wildlife and vegetation were identified as the controlling flows, as determined by the floodplain transect method and the MesoHABSIM model. The selection of the highest flow need as the protected flow magnitudes is tempered by the description of allowable and catastrophic durations keyed to their natural frequency of occurrence. Flows below these magnitudes are expected to occur frequently, but not for durations longer than naturally occurring.

The protected instream flows for the upper and lower Souhegan portions are keyed to an index location within that portion. The lower Souhegan index location is the USGS stream flow gage (01094000) Souhegan River near Merrimack. The upper Souhegan index location is Souhegan River gage SR-25, where a temporary flow measurement station was established

during the study and a flow relationship with the USGS gage was developed. The protected flows are described as a daily mean flow in cubic feet per second or cfs. One cubic foot per second is roughly 449 gallons per minute or 0.65 million gallons per day. The protected flows are also described in terms of flow per unit area as cfs per square mile of drainage area (cfsm.) Using this term, the protected instream flow can be prorated to upstream and downstream locations from the index location based on its contributing upstream drainage area. Comparison of the daily mean stream flow at an index location to the protected instream flow conditions determines if the protected flow is being met such that flow management should be considered.

Evaluating Flow Conditions Under the Protected Instream Flows

Evaluation of flow conditions will be based on tracking and comparing the river flows to the protected instream flows. Stream flow conditions relative to the protected instream flows can be identified as being "typical," "persistent," or "catastrophic." Flows within the desirable range exist when stream flows are at levels above a protected magnitude or below a protected magnitude for durations shorter than the allowable duration. These flow conditions are termed typical.

A management event occurs when conditions become catastrophic. An event can occur in several ways. Flow below a protected magnitude for more than the allowable duration, but less than the catastrophic duration is a persistent condition. A persistent condition does not in itself cause a management event, but a persistent condition that occurs for three consecutive years or three consecutive bioperiods is considered a catastrophic condition and triggers management on the inception of an event in the third year. Flow below a protected magnitude for durations longer than the catastrophic duration is a catastrophic condition and triggers management. Flow durations below a protected magnitude can be reset to zero by relief flows represented by a two-day increase in flow above the next higher protected flow magnitude. For example, flows that increased above the critical flow magnitude for two days would reset the count of the number of days of duration below the rare flow magnitude. These relief flow events can be created naturally or artificially. Flow durations are also reset to zero at the beginning of a new bioperiod.

How the Protected Instream Flows meet Water Quality Standards

These Souhegan Protected Instream Flows were developed to maintain and protect Clean Water Act designated uses related to stream flow. New Hampshire Water Quality Standards Env-Ws 1703.01 (b) and (c) require that all surface waters shall be restored to maintain the chemical, physical, and biological integrity of surface waters, and that all surface waters shall provide, wherever attainable, for the protection and propagation of fish, shellfish and wildlife, and for recreation in and on surface waters. Env-Ws 1703.01 (d) requires that unless the flows are caused by naturally occurring conditions, surface water quantity shall be maintained at levels adequate to protect existing and designated uses. Designated uses applicable to instream flow include aquatic life and recreation. Under Env-Ws 1703.19, surface waters are required to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.

By developing these protected instream flows under the Natural Flow Paradigm, which recognizes and accommodates the flow requirements of biological communities, specifically by incorporating the variability of flow over daily to annual time scales, and evaluating species adapted to the Souhegan watershed conditions, the resulting instream flow protection applies river-specific criteria to meet the flow protection needs across the full range of the historical stream flows. These protected flows maintain stream flow within ranges consistent with natural conditions. The protected instream flows maintain the flow-dependent chemical, physical, and biological integrity of surface waters, provide for the protection and propagation of fish, shellfish and wildlife, and also provide for recreation opportunities consistent with natural conditions.

Summary of Comments

Public participation has repeatedly been sought during the development of the Souhegan Protected Instream Flows. As required by Laws of 2002, Chapter 278, advisory committees, the Technical Advisory Committee and the Water Management Planning Area Advisory Committee, were convened. Advisory committee meetings, open to the public, were widely advertised during this process. Input from technical experts and stakeholders at these meetings was incorporated into revisions of interim reports and into the assessment processes. The advisory committees were vital in shaping a well developed Proposed Protected Instream Flow report for the public hearing. The report was presented on March 21, 2007 at a public hearing held in Milford, NH, as prescribed by Laws of 2002, Chapter 278:3.III (a). The public hearing presented the report and described the processes used to define the protected flows. Comments were solicited at the hearing and via email. The 30-day comment period was completed April 20, 2007.

A few comments heard during the hearing focused on clarifications of the presentation. Questions were answered during the hearing and are summarized below. Questions asked were:

- Where was the river divided into two assessment portions? (Response: The Designated River was divided in west Milford at a location below Stony Brook).
- Should dam removals be used to improve habitat? (Response: Dam removals are effective in recreating riverine habitat, but dam removals are not part of the Instream Flow Program).
- Why were shad and salmon part of the assessment when they don't naturally occur now? (Response: These species are thought to have been present in the Souhegan at one time. The Souhegan Instream Flow Program, therefore, identifies the flows that support shad and salmon and other species that do or should occur. These anadromous species are especially of interest since the future removal of the dam in Merrimack may allow access for these species to the Souhegan from the Merrimack River.)
- Can future growth be accommodated under the Instream Flow Program? (Response: Yes, the instream flows are defined and remain stable quantities, but the management plans are expected to be revised as water use and management needs change. Future needs will require accommodation of new water uses by existing water users and dam owners. New water users may choose different water use strategies to return water locally instead of returning the water away from its withdrawal location).
- What is the amount of storage needed to meet the protected flows? (Response: Existing storage in the Souhegan watershed is limited in volume and may be further limited by

temperature concerns of releasing stored water. Dam management sub-plans will prescribe use of existing storage, taking these factors into account.)

During the comment period following the hearing, DES received written comments on the Souhegan River Protected Instream Flow Report from the US Fish and Wildlife Service (USF&WS) and the US Environmental Protection Agency (EPA). The USF&WS's and EPA's comments and DES's responses are documented in Appendix 18 - Responses to Public Comments, an addendum to the Souhegan Protected Instream Flow Report.

The addition of Appendix 18 to the report allowed the authors to provide very detailed discussions beyond what was appropriate for the main report. DES's responses to written comments largely provided correction or clarification of the commenters' understanding of the process and additional details.

DES clarified and provided documentation addressing EPA's comment concerning assumptions about how the number of parameters necessary to determine fish preferences for habitat was determined. EPA also asked for a flow chart describing the model inputs. This was presented in a simplified format with written addition of Appendix 17, which includes detailed discussion of the modeling details. EPA also suggested presenting the MesoHABSIM results in the format of PHABSIM results using Weighted Usable Area rating curves to evaluate situations where habitat quantity was low due to variables other than flow conditions. However, the consultants pointed out that using different metrics would not improve the resolution problems caused by low habitat quantity from impaired conditions.

USF&WS expressed reservations about using the MesoHABSIM model, saying they would like more testing and critical review conducted despite the inclusion of this method in the pilot for the previous three years. The proposed method for determining protected flows had been part of the selection criteria for hiring a consultant. The consulting group was selected based in part on their proposal to use MesoHABSIM. Later, the method was vetted by the Souhegan Technical Review Committee and approved for use. The Souhegan Technical Review Committee members, which include a US Fish and Wildlife Service representative, are appointed because of their education or experience in water resources management or protection. The Souhegan Technical Review Committee approved using MesoHABSIM and also approved presenting the protected instream flows, resulting chiefly from the MesoHABSIM method, at the public hearing. In response to this comment, DES is preparing to conduct a third-party review of the methods and results of the Pilot Program, which would focus on the MesoHABSIM model. The review would become part of the final evaluation of the Pilot Program presented to the legislature.

DES clarified and provided additional documentation addressing USF&WS's comments concerning:

- Development of habitat suitability criteria.
- Collection and processing of fish data.
- Differences between MesoHABSIM and PHABSIM, another habitat simulation model, concerning the methods of hydraulic assessment and interpolation between flows.

- The underlying assumption of habitat models that habitat availability correlates positively with population, but is not predictive of biological and chemical relationships.
- Resolution of habitat assessments and the statistical basis for the number of measurements made in each habitat area.
- Despite flow being a master variable, flow conditions are not the only variable affecting fish populations. Habitat models can correctly include the impacts of these variables. Species are sensitive to factors including temperature, channel dimension, and lack of input of woody debris.
- Interpretation of model verification results.
- The statistical method used in the time-series analysis was created by Capra et al.[3] It was not used for the same study purposes as the original author used it for, but the method is a statistical tool that also applies to these data.
- Habitat rating curves are not appropriately used to identify protected flows relying on negotiation or picking a point on a curve. Instead time-series analysis allows picking protected flows with biological significance based on identifying slope changes or "break points" in habitat availability and protecting the duration and frequency of these indicators.

How the Comments Affected the Final Instream Flows

None of the commenters requested changes in the protected instream flows or revisions affecting the protected instream flow values. The comments did not result in any changes to the protected instream flow values. No processes or computations were revised as a result of comments. The comments resulted in clarifications that were added to the report or carried in Appendix 18 – Response to Public Comments. The comments resulted in increased detail of documentation describing the process of developing the instream flows.

[3] Capra, H., B. Pascal, & Y. Souchon. 1995. A new tool to interpret magnitude and duration of fish habitat variations. Regulated Rivers: Research & Management 10: 281-289.